Stellaris® EK-LM3S9B92 Evaluation Kit

User's Manual

EK-LM3S9B92-03

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CHAPTER 1

Stellaris® LM3S9B92 Evaluation Kit Overview

Luminary Micro's Stellaris® LM3S9B92 Evaluation Board Kit (EK-LM3S9B92) is a low-cost platform for evaluation of the LM3S9B92 microcontroller. The kit includes two boards, the EK-LM3S9B92 evaluation board, and the In-Circuit Debug Interface (BD-ICDI) board.

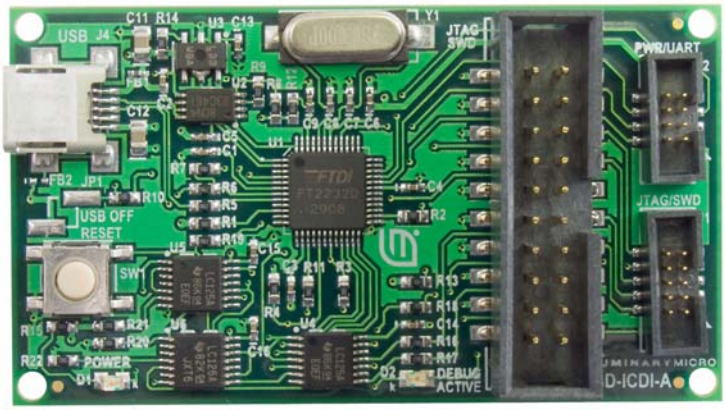
The EK-LM3S9B92 board includes the LM3S9B92 ARM® Cortex™-M3 Microcontroller, a 10/100 Mbit Ethernet port, a full-speed USB-OTG port, connectors for inteface to the BD-ICDI board, and oversized pads for easy connection to the microcontroller GPIO ports.

The BD-ICDI board is a USB full-speed JTAG/SWD debugger board. It includes a USB miniB connector for connection to a USB PC port, and two shrouded header connectors for connection to the EK-LM3S9B92 board.

Development of software for the EK-LM3S9B92 is simplified by using Luminary Micro's comprehensive StellarisWare® peripheral driver library and ARM development tools from our tools partners. The Stellaris® LM3S9B92 Evaluation Board Kit includes the two boards described, a documentation CD, and cables. All design files are provided on the EK-LM3S9B92 CD.

Figure 1-1. LM3S9B92 Evaluation Board

Figure 1-2. In-Circuit Debug Interface Board



Kit Contents

The EK-LM3S9B92 evaluation kit comes with the following:

- EK-LM3S9B92 evaluation board
- In-Circuit Debug Interface (BD-ICDI) board
  - Connects to USB port on PC and to 10-pin, fine-pitch ARM JTAG connector on the EK-LM3S9B92 evaluation board
  - Secondary 8-pin Power/UART connector provides power and virtual comm-port capability to the EK-LM3S9B92 evaluation board.
- Cables
  - USB miniB to USB-A cable
  - USB-OTG to USB-A cable
  - 10-pin ribbon cable for JTAG/SWD connection
  - 8-pin ribbon cable for Power/UART connection
- Evaluation Kit CD
  - Complete documentation, including Quickstart and User's Manual
  - Complete source code, schematics, and PCB gerber files

    The source code can be modified and compiled using tools from Keil and IAR as well as the Gnu C Compiler for ARM® Cortex™-M3. Complete GCC tool-chains include those from CodeSourcery and CodeRed.

Using the EK-LM3S9B92

The recommended steps for using the EK-LM3S9B92 evaluation kit are:

1. **Follow the Quickstart guide included in the kit.** The Quickstart guide will help get the EK-LM3S9B92 LC Evaluation Board up and running in minutes.
2. **Use your preferred ARM tool-chain and the Luminary Micro Peripheral Driver Library to develop an application.** Software applications are loaded using the BD-ICDI board. See Chapter 3, “Software Development,” for the programming procedure. The *StellarisWare Peripheral Driver Library Software Reference Manual* contains specific information on software structure and function.
3. **Customize and integrate the hardware to suit an end application.** This user's manual is an important reference for understanding circuit operation and completing hardware modification.

Features

The EK-LM3S9B92 evaluation kit provides the following features:

- LM3S9B92 high-performance Stellaris microcontroller and large memory
  - 32-bit ARM® Cortex™-M3 core
  - 256 KB single-cycle Flash memory, 96 KB single-cycle SRAM, 23.7 KB single-cycle ROM
- Ethernet 10/100 port with two LED indicators
- USB 2.0 Full-Speed OTG port

- Virtual serial communications port capability
- Oversized board pads for GPIO access
- User pushbutton and LED
- Detachable ICDI board can be used for debugging other Luminary Micro boards
- Easy to customize
  - Includes full source code, example applications, and design files
  - Develop using tools supporting FastMATH from Keil, IAR, Code Sourcery, and Code Red (using a Stellaris evaluation kit or preferred ARM Cortex-M3 debugger)
  - Supported by Luminary Micro StellarisWare peripheral driver library

CHAPTER 2

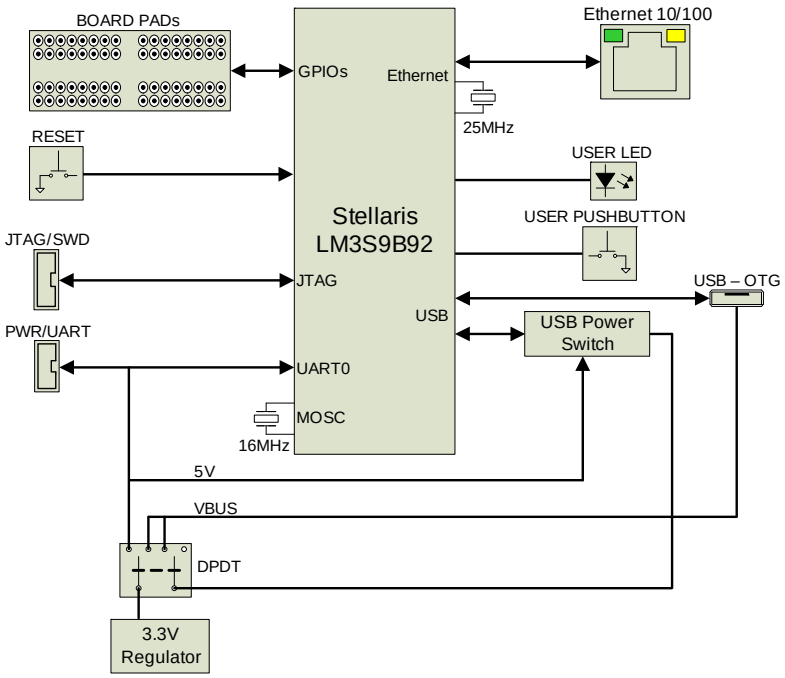
Hardware Description

The EK-LM3S9B92 evaluation kit contains two boards: the EK-LM3S9B92 evaluation board and the BD-ICDI JTAG debug board as described in more detail in this chapter.

Evaluation Board

The EK-LM3S9B92 evaluation board uses the Stellaris® LM3S9B92 microcontroller and includes a 10/100 Ethernet port and a USB 2.0 full-speed OTG port. The board is intended for use with the ICDI board, but can be used as a standalone board as well. Figure 2-1 shows the block diagram.

Figure 2-1. EK-LM3S9B92 Evaluation Board Block Diagram



Functional Description

Microcontroller, Reset, GPIO Pads, and JTAG (Schematic page 1)

Microcontroller

The evaluation board uses the Stellaris EK-LM3S9B92 microcontroller. A 16 MHz crystal provides the main oscillator clock which can directly drive the ARM core clock or can drive an internal PLL to increase the core clock up to 80 MHz. A 25 MHz crystal is used for the Ethernet clock.

The LM3S9B92 microcontroller has an internal LDO voltage regulator that supplies power for internal use. This rail requires only three capacitors for decoupling and is not connected to any other circuits.

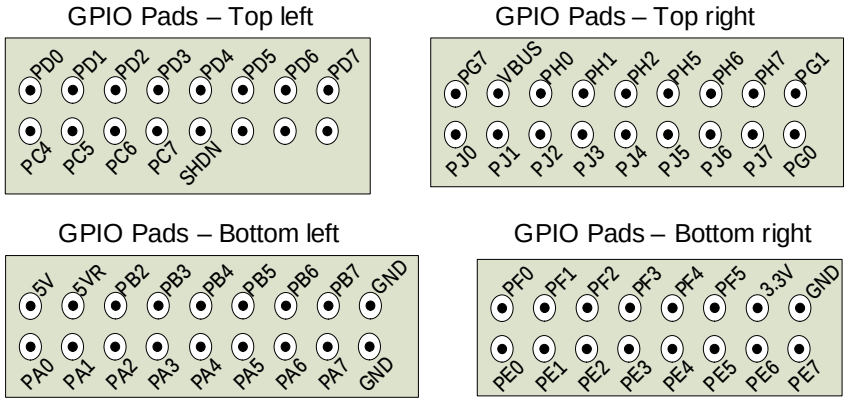
Reset

A reset switch and R-C network connects to the microcontroller's RSTn input. The reset signal is also connected to the JTAG/SWD connector J1 to allow reset control from the debugger.

GPIO Pads

Four groups of oversized board pads with a 0.1" spacing provide access to GPIO signals and standard 0.1" pitch headers can be soldered to these pads. Pads are labeled with the corresponding GPIO signal, and pads with no labels are unconnected. Note that GPIO signals required for operation of the Ethernet port, USB port, and JTAG port are reserved for board use and are not available on these pads. Figure 2-2 shows the pad groups.

Figure 2-2. GPIO Pads


GPIO Pads – Top left
PD0 PD1 PD2 PD3 PD4 PD5 PD6 PD7
PC4 PC5 PC6 PC7 SHDN
GPIO Pads – Top right
PG7 VBUS PH0 PH1 PH2 PH5 PH6 PH7 PG1
PJ0 PJ1 PJ2 PJ3 PJ4 PJ5 PJ6 PJ7 PG0
GPIO Pads – Bottom left
5V 5VR PB2 PB3 PB4 PB5 PB6 PB7 GND
PA0 PA1 PA2 PA3 PA4 PA5 PA6 PA7 GND
GPIO Pads – Bottom right
PF0 PF1 PF2 PF3 PF4 PF5 3.3V GND
PE0 PE1 PE2 PE3 PE4 PE5 PE6 PE7

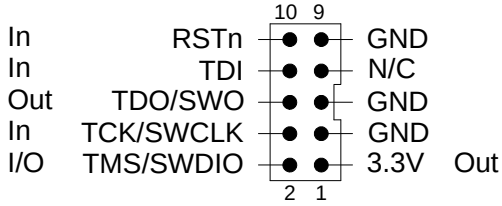
GPIO Jumpers

Some of the GPIO signals used by the board are connected to board jumpers and can be disconnected to provide additional user GPIOs. GPIOs PA0/PA1/PB4/PD0/PF2/PF3 are connected to jumpers JR1-JR6 respectively. Each signal can be freed by cutting the trace of the corresponding jumper (cut at white line on silkscreen). The jumper pads have the same footprint as an 0603 SMT resistor. To reconnect a previously cut jumper, solder a 0 ohm resistor to the corresponding jumper footprint.

JTAG/SWD

The JTAG/SWD connector J1 is used for program download and debug. This is a 2x5 fine pitch (0.050") ARM JTAG connector, see (Figure 2-3) for signal definition. The LM3S9B92 microcontroller supports JTAG debug, Serial Wire Debug (SWD), and Serial Wire Out (SWO) trace with this connector. The ICDI board connects via a 10-wire ribbon cable to this connector.

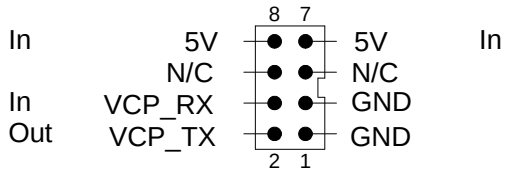
Figure 2-3. JTAG/SWD Connector



PWR/UART

The PWR/UART connector J2 is used to provide 5 V power from the ICDI board and also to connect the LM3S9B92 UART0 signals. This is a 2x4 fine pitch (0.050") connector, see (Figure 2-4) for signal definition. The UART0 signals are connected to GPIO jumpers JR1 and JR2 and can be disconnected from connector J2 if required, see "GPIO Jumpers" on page 14. The ICDI board connects via an 8-wire ribbon cable to this connector.

Figure 2-4. PWR/UART Connector



Ethernet, USB, Power and Miscellaneous (Schematic page 2)

Page 2 of the schematics contains the Ethernet RJ45 connector, USB power switch and USB OTG connector, 3.3 V regulator, and power switch selector.

Ethernet Port

The on-board RJ45 connector provides a 10/100 base T Ethernet port. The RJ45 connector includes integrated LEDs and magnetics. The LEDs are connected to GPIO jumpers JR4 and JR5 and can be disconnected from the RJ45 connector if required, see GPIO Jumpers section.

USB Port

The on-board USB microAB connector provides a USB 2.0 full-speed port. To use as an On-The-Go (OTG) port, the power selector switch SW3 lever must be set to EXT. This selects an external 5 V power source to provide power to the board and the USB power switch. If the SW3 lever is set to USB, power to the board is received from USB, the on-board USB power switch output is disconnected from USB, and the board can only be used as a USB device. When using the USB-OTG port in Host mode, the current provided to a USB device should be limited to 100 mA or less when powered from the ICDI board. If powered from the 5 V test pad, then this can be increased to 500 mA.

Board Power

The board requires 5 V for operation, and switch SW3 is used to select the power source. If the switch lever is moved towards the USB label on the board, power is received from the USB connector. If the switch lever is moved towards the EXTernal board label, the board is powered from the PWR/UART connector and the ICDI board provides power to this connector. DC regulator U2 generates 3.3 V for powering the board circuits and includes power indicator LED D1.

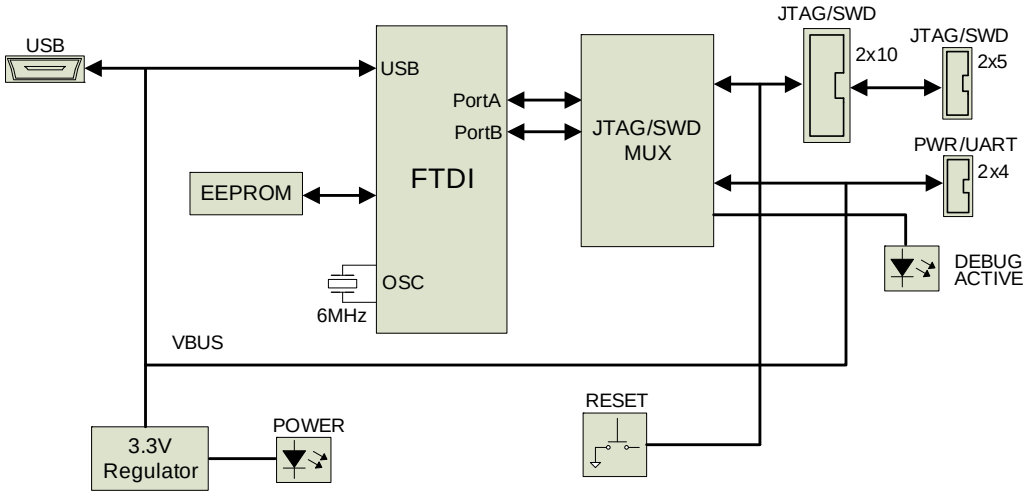
User Devices

Pushbutton switch SW2 and LED D2 are available for the user and connected to PB4 and PD0 respectively. These GPIOs are connected to GPIO jumpers JR3 and JR4 and can be disconnected from SW2 and D2 if required, see GPIO Jumpers section.

In-Circuit Debug Interface Board

The ICDI board is used to download and debug programs on the EK-LM3S9B92 evaluation board, but can also be used for debug of other Luminary Micro boards. A block diagram is shown in Figure 2-5.

Figure 2-5. In Circuit Debug (ICDI) Board Block Diagram



Functional Description

USB to JTAG/SWD, Power (Schematic page 1)

USB

An FTDI USB to serial protocol chip is used for the USB 2.0 full-speed device controller. This is connected to a USB miniB connector and to a set of buffers/multiplexers. A 1-kbit serial EEPROM contains USB configuration data which is read at power up.

Power

The board receives 5 V power from the USB bus. A DC regulator generates 3.3 V for on-board circuits, when on LED D1 (POWER) is lit on.

Headers

Three headers are on-board, a 10-pin JTAG/SWD header J1, an 8-pin PWR/UART header J2, and an optional 20-pin JTAG/SWD header J3. The 10-pin and 8-pin headers are used to connect to the EK-LM3S9B92 evaluation board.

JTAG/SWD

JTAG/SWD connector J1 connects to the EK-LM3S9B92 evaluation board with a ribbon cable for program download and debug. This is a 2x5 fine pitch (0.050”) ARM JTAG connector, see (Figure 2-6) for signal definition.The ICDI supports JTAG debug, SWD (Serial Wire Debug), and SWO (Serial Wire Out) trace with this connector.

Optional JTAG/SWD connector J3 is a 2x10 standard pitch (0.1”) ARM JTAG connector directly connected to J1, see (Figure 2-7) for signal definition. This allows the ICDI to connect to targets that use a 2x10 connector. It also allows the use of an external 2x10 debugger on targets with the

fine pitch connector, including the EK-LM3S9B92. The signal direction shown for J1 and J3 applies when the ICDI is used as the JTAG/SWD debugger and LED D2 (DEBUG ACTIVE) is lit on. In this case only one of the two connectors J1/J3 should be used.

The ICDI can also be used as a 20-pin to 10-pin adapter for external JTAG debuggers. Note that the DEBUG ACTIVE LED must be off before connecting any external JTAG debuggers.

Figure 2-6. JTAG/SWD Connector J1

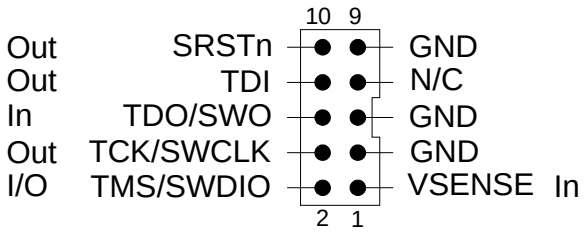
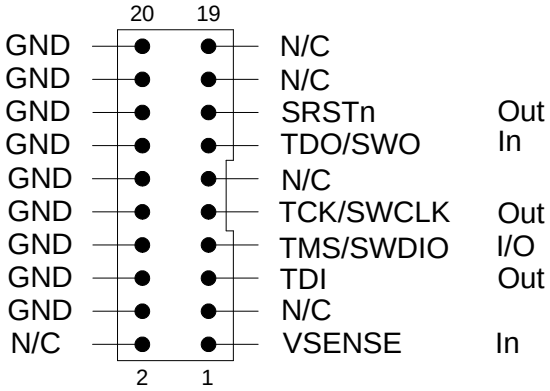


Figure 2-7. JTAG/SWD Connector J3



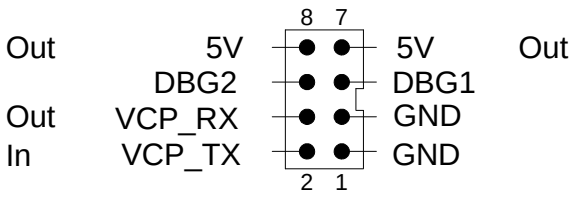
Pushbutton

Pushbutton SW1 (RESET) is provided to manually generate the SRSTn signal to the target device. The SRSTn signal can also be generated under program control.

PWR/UART

The PWR/UART connector J2 connects to the EK-LM3S9B92 evaluation board with a ribbon cable and provides 5 V power and a virtual communications port connection. This is a 2 x 4 fine pitch (0.050") connector, see (Figure 2-8) for signal definition. Signals DBG1/DBG2 are reserved.

Figure 2-8. PWR/UART Connector



JTAG / SWD Multiplexer (Schematic page 2)

Buffers

A set of tri-state buffers is used to multiplex JTAG and SWD signals, and also multiplex the UART VCP_TX signal with the SWO signal. LED D2 (DEBUG ACTIVE) is lit on when these buffers are enabled. To avoid signal contention, external JTAG debuggers should not be connected when DEBUG ACTIVE is on.

CHAPTER 3

Software Development

This chapter provides general information on software development as well as instructions for Flash memory programming.

Software Description

The software provided with the EK-LM3S9B92 provides access to all of the peripheral devices supplied in the design. The StellarisWare® Peripheral Driver Library is used to operate the on-chip peripherals.

The software includes a set of example applications that utilize the StellarisWare Peripheral Driver Library. These applications demonstrate the capabilities of the LM3S9B92 microcontroller, as well as providing a starting point for the development of the final application for use on the EK-LM3S9B92.

Source Code

The complete source code is included on the EK-LM3S9B92 CD. Refer to the Quickstart Guide for a detailed description of hardware setup and how to install the source code. The source code and binary files are installed in the DriverLib tree.

Tool Options

The source code installation includes directories containing projects and/or makefiles for the following tool-chains:

- Keil ARM RealView® Microcontroller Development System
- IAR Embedded Workbench for ARM
- CodeSourcery G++
- Code Red Technology Red Suite
- Generic Gnu C compiler

Evaluation versions of these tools may be downloaded from www.luminarymicro.com. Due to code size restrictions, the evaluation tools may not build all example programs. A full license is necessary to re-build or debug all examples.

Instructions on installing and using each of the evaluation tools can be found in the Quickstart guides (for example, Quickstart-Keil, Quickstart-IAR) which are available for download from the evaluation kit section of our web site at www.luminarymicro.com.

For detailed information on using the tools refer to the documentation included in the tool chain installation or visit the website of the tools supplier.

Programming the EK-LM3S9B92 Board

The EK-LM3S9B92 software package includes pre-built binaries for each of the example applications. If you installed DriverLib to the default installation path of C:/DriverLib, you can find the example applications in “C:/DriverLib/boards/ek-tempest”. The ICDI board is used along with Luminary Micro's LM Flash Programmer tool to program applications on the EK-LM3S9B92 board.

To program example applications into the EK-LM3S9B92 evaluation board using the ICDI board:

1. Install LM Flash Programmer on a Windows PC.
2. Connect the 10-wire ribbon cable to the 10-pin header on the ICDI board and to the 10-pin header on the EK-LM3S9B92 board. The red stripe on the ribbon cable should be facing the bottom of the connectors (see Figure B-5 on page 29).
3. Connect the 8-wire ribbon cable to the 8-pin header on the ICDI board and to the 8-pin header on the EK-LM3S9B92 board. The red stripe on the ribbon cable should be facing the bottom of the connectors (see Figure B-5 on page 29).
4. Verify that slide switch SW3 on the EK-LM3S9B92 board is set to EXTernal.
5. Connect the USB cable A-plug to an available port on the PC and the miniB-plug to the ICDI board.
6. Verify that POWER LED D1 on the ICDI board is lit and POWER LED D1 on the EK-LM3S9B92 board is also lit.
7. Run LM Flash Programmer.
8. In the Configuration tab, use the Quick Set control to select LM3S9B92 Evaluation Board.
9. Move to the Program tab and click the Browse button. Navigate to the example applications directory (the default location is “C:/DriverLib/boards/ek-tempest/).
10. Each example application has its own directory. Navigate into the example directory that you want to load and then into the directory which contains the binary (*.bin) files. Select the binary file and click Open.
11. Set the “Erase Method” to “Erase Necessary Pages” and check the “Verify After Program” box.
12. Next, click the Program button to start the Erase, Download and Verify process. The DEBUG ACTIVE LED (D2) on the ICDI will turn on at this time.
13. Program execution will start once Verify is complete.

The EK-LM3S9B92 design uses a Stellaris® LM3S9B92 microcontroller to handle networking, USB-OTG, and peripheral functions. The entire circuit is built on a compact four-layer printed circuit board. All design files are provided on the EK-LM3S9B92 CD.

APPENDIX A

Schematics

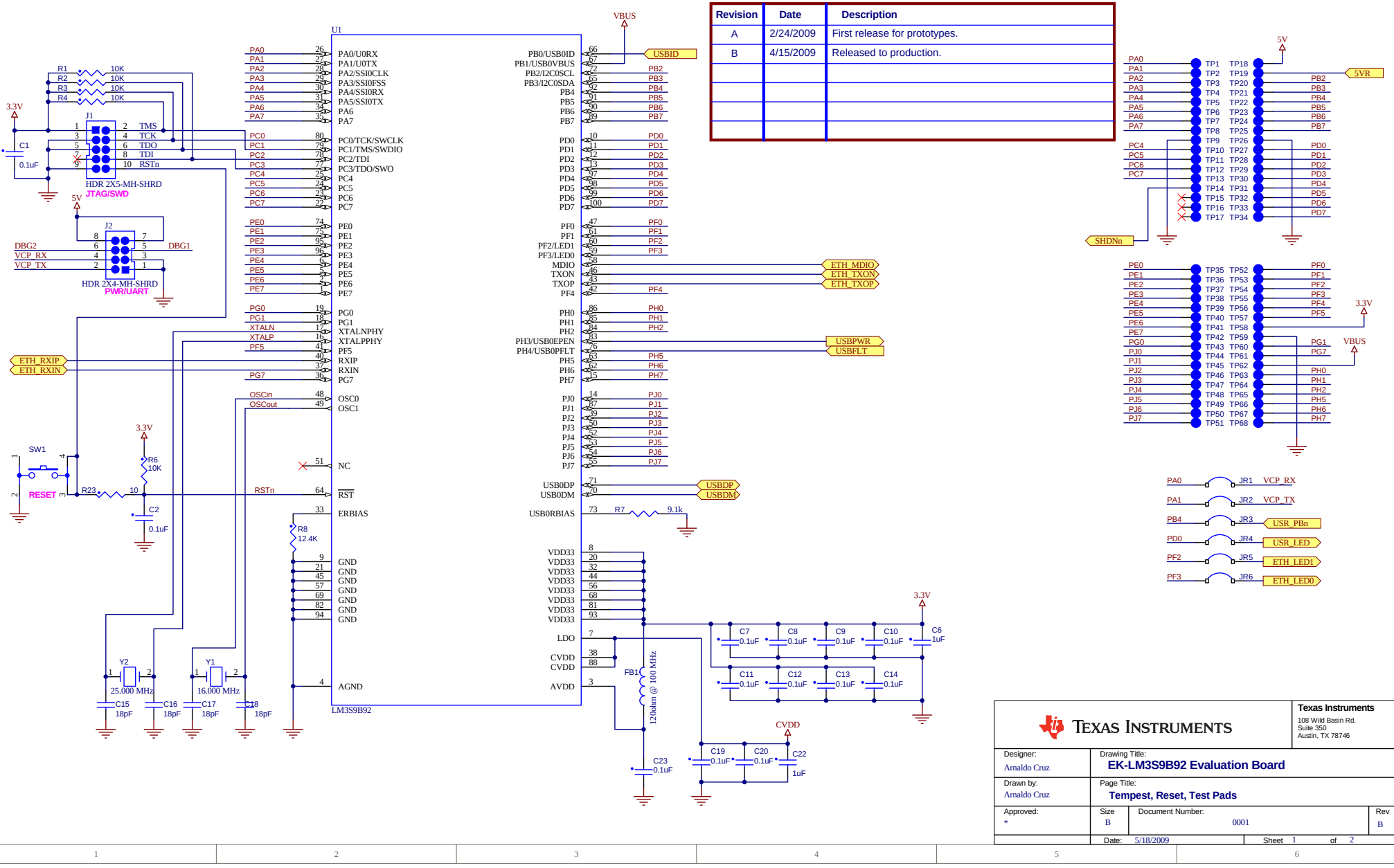
This section contains the schematics for the EK-LM3S9B92 evaluation board and also the BD-ICDI debug board.

EK-LM3S9B92 Evaluation Board

- Microcontroller, Reset, and Headers on page 22
- Ethernet, USB, and Power on page 23

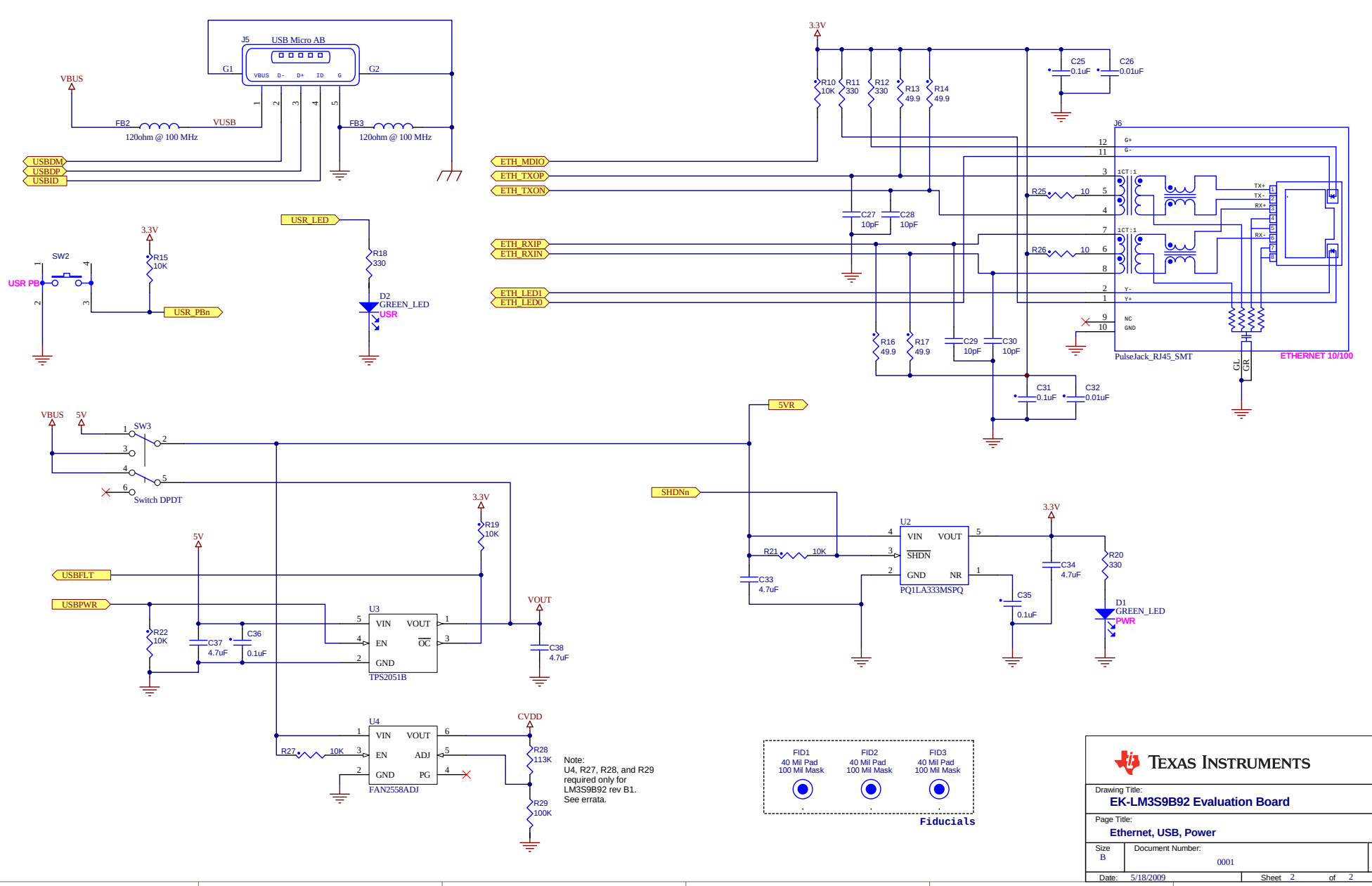
BD-ICDI Board

- USB to JTAG, SWD, Headers, and Power on page 24
- JTAG/SWD Multiplexer on page 25



Revision	Date	Description
A	2/24/2009	First release for prototypes.
B	4/15/2009	Released to production.

Texas Instruments	108 Wild Basin Rd. Suite 350 Austin, TX 78746
Designer: Arnaldo Cruz	Drawing Title: EK-LM3S9B92 Evaluation Board
Drawn by: Arnaldo Cruz	Page Title: Tempest, Reset, Test Pads
Approved: *	Size: B; Document Number: 0001; Rev: B
	Date: 5/18/2009; Sheet 1 of 2


J5
USB Micro AB
VBUS
G1
G2
D-
D+
ID
FB2
VUSB
120ohm @ 100 MHz
FB3
USBDM
USBDP
USBID
3.3V
SW2
USR PB
R15
10K
USR_PBn
USR_LED
R18
330
D2
GREEN_LED
USR
ETH_MDIO
ETH_TXOP
ETH_TXON
ETH_RXIP
ETH_RXIN
ETH_LED1
ETH_LED0
R10
10K
R11
330
R12
330
R13
49.9
R14
49.9
C25
0.1uF
C26
0.01uF
C27
10pF
C28
10pF
R25
10
R26
10
J6
1CT:1
TX+
TX-
RX+
RX-
NC
GND
PulseJack_RJ45_SMT
ETHERNET 10/100
R16
49.9
R17
49.9
C29
10pF
C30
10pF
C31
0.1uF
C32
0.01uF
VBUS
5V
SW3
Switch DPDT
5VR
SHDNn
3.3V
R19
10K
USBFLT
USBPWR
R22
10K
C37
4.7uF
C36
0.1uF
U3
VIN
VOUT
EN
OC
GND
TPS2051B
VOUT
C38
4.7uF
U2
SHDN
NR
PQ1LA333MSPQ
R21
10K
C33
4.7uF
C34
4.7uF
C35
0.1uF
R20
330
D1
GREEN_LED
PWR
U4
ADJ
PG
FAN2558ADJ
CVDD
R27
10K
R28
113K
R29
100K
Note:
U4, R27, R28, and R29
required only for
LM3S9B92 rev B1.
See errata.
FID1
40 Mil Pad
100 Mil Mask
FID2
40 Mil Pad
100 Mil Mask
FID3
40 Mil Pad
100 Mil Mask
Fiducials
TEXAS INSTRUMENTS
Drawing Title:
EK-LM3S9B92 Evaluation Board
Page Title:
Ethernet, USB, Power
Size
B
Document Number:
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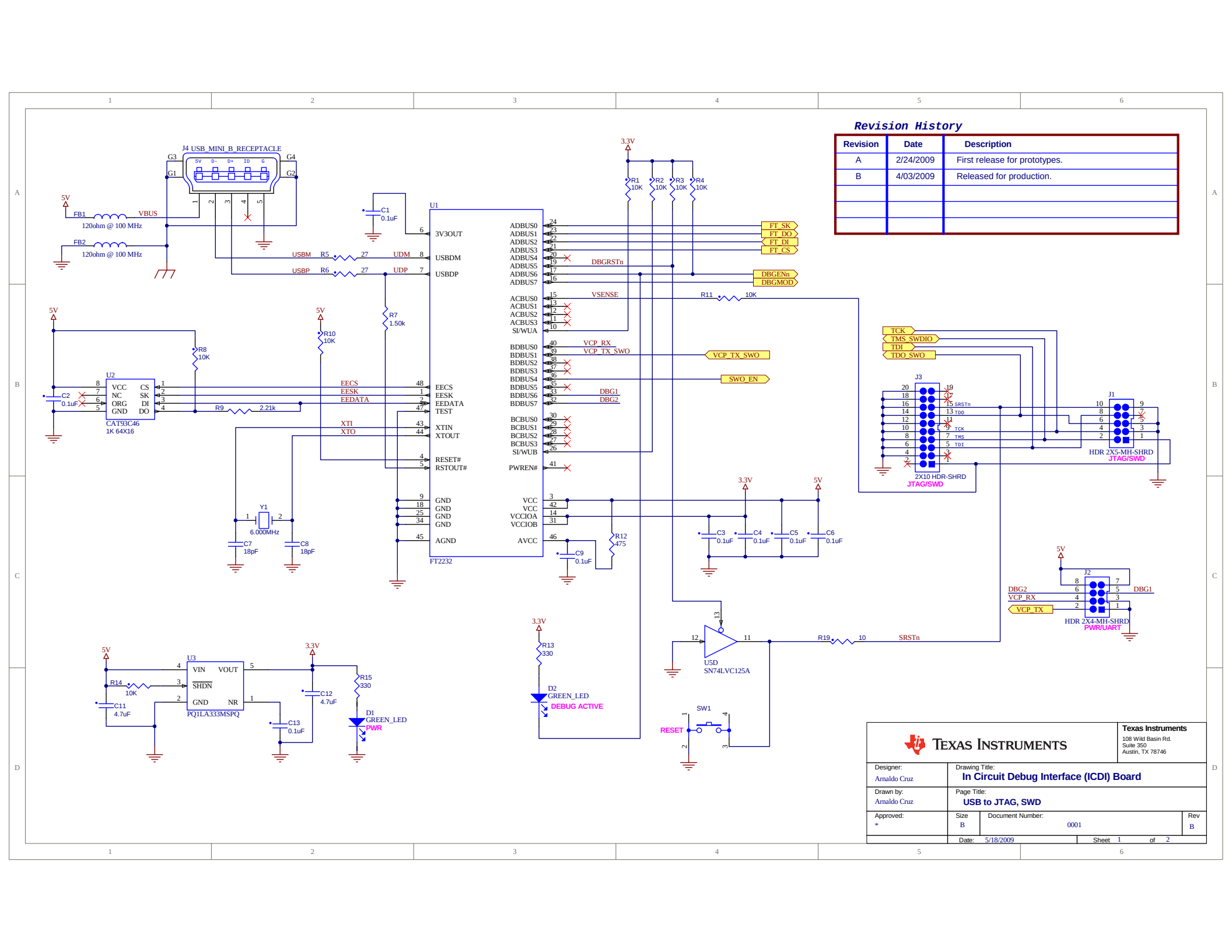
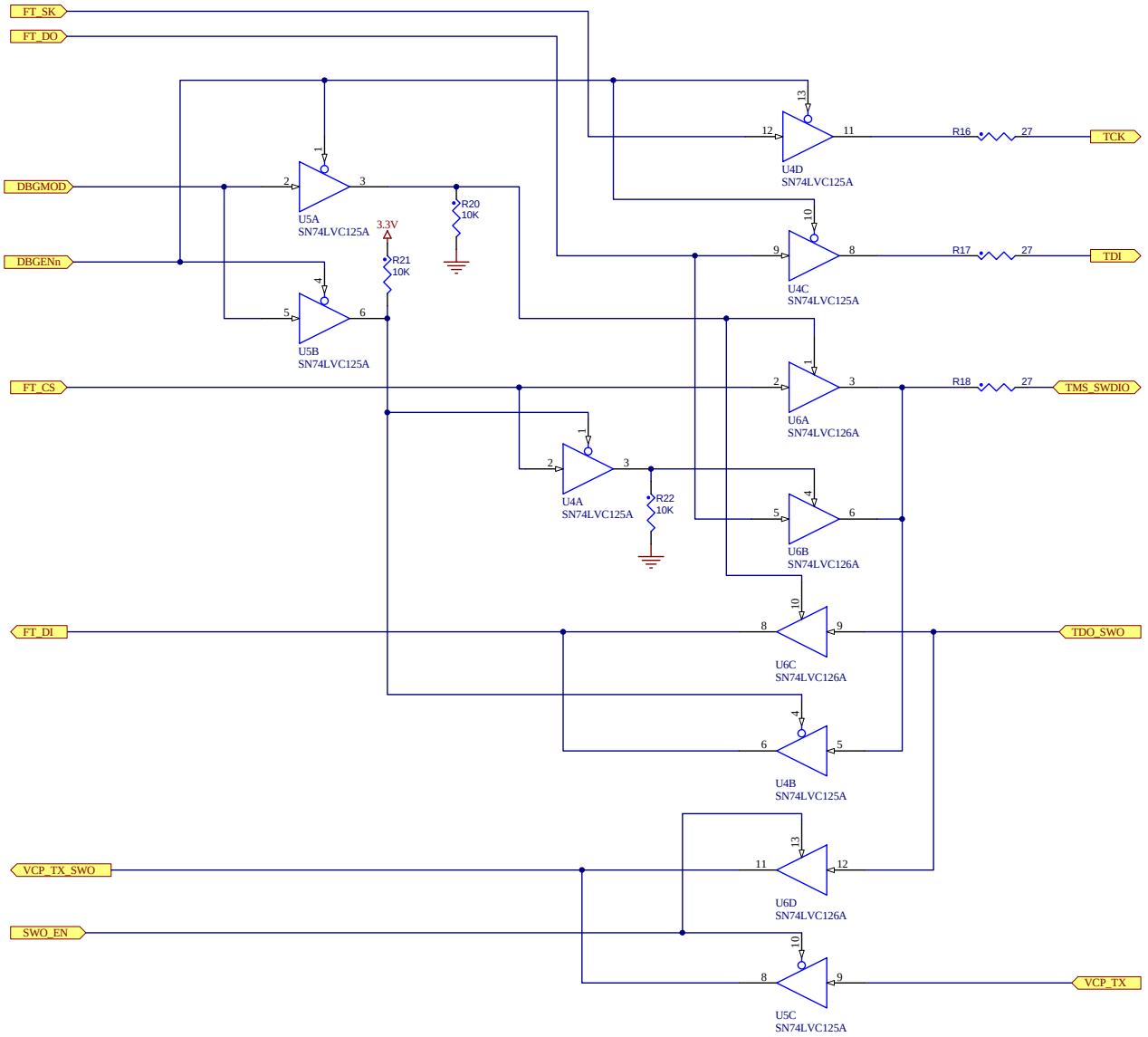
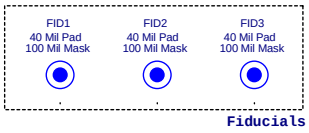
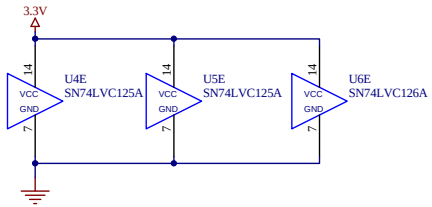
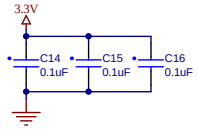
Rev
B
Date:
5/18/2009
Sheet
2
of
2


Revision History
Revision | Date | Description
A | 2/24/2009 | First release for prototypes.
B | 4/03/2009 | Released for production.
J4 USB_MINI_B_RECEPTACLE
FB1 120ohm @ 100 MHz
FB2 120ohm @ 100 MHz
VBUS
U1
FT2232
3V3OUT
USBDM
USBDP
USBM
USBP
R5 27
R6 27
UDM
UDP
R7 1.50k
C1 0.1uF
R1 10K
R2 10K
R3 10K
R4 10K
ADBUS0
ADBUS1
ADBUS2
ADBUS3
ADBUS4
ADBUS5
ADBUS6
ADBUS7
FT_SK
FT_DO
FT_DI
FT_CS
DBGRSTn
DBGENn
DBGMOD
ACBUS0
ACBUS1
ACBUS2
ACBUS3
SI/WUA
VSENSE
R11 10K
BDBUS0
BDBUS1
BDBUS2
BDBUS3
BDBUS4
BDBUS5
BDBUS6
BDBUS7
VCP_RX
VCP_TX_SWO
SWO_EN
DBG1
DBG2
BCBUS0
BCBUS1
BCBUS2
BCBUS3
SI/WUB
PWREN#
RESET#
RSTOUT#
EECS
EESK
EEDATA
TEST
XTIN
XTOUT
XTI
XTO
GND
AGND
VCC
VCCIOA
VCCIOB
AVCC
R12 475
C9 0.1uF
C3 0.1uF
C4 0.1uF
C5 0.1uF
C6 0.1uF
U2
CAT93C46
1K 64X16
VCC
NC
ORG
GND
CS
SK
DI
DO
C2 0.1uF
R8 10K
R9 2.21k
R10 10K
Y1
6.000MHz
C7 18pF
C8 18pF
J3
2X10 HDR-SHRD
JTAG/SWD
TCK
TMS_SWDIO
TDI
TDO_SWO
SRSTn
TDO
TMS
TDI
J1
HDR 2X5-MH-SHRD
JTAG/SWD
J2
HDR 2X4-MH-SHRD
PWR/UART
DBG2
VCP_RX
VCP_TX
DBG1
U5D
SN74LVC125A
R19 10
SRSTn
U3
PQ1LA333MSPQ
VIN
VOUT
SHDN
GND
NR
R14 10K
C11 4.7uF
C12 4.7uF
C13 0.1uF
R15 330
D1
GREEN_LED
PWR
R13 330
D2
GREEN_LED
DEBUG ACTIVE
SW1
RESET
TEXAS INSTRUMENTS
Texas Instruments
108 Wild Basin Rd.
Suite 350
Austin, TX 78746
Designer: Arnaldo Cruz
Drawing Title: In Circuit Debug Interface (ICDI) Board
Drawn by: Arnaldo Cruz
Page Title: USB to JTAG, SWD
Approved: *
Size: B
Document Number: 0001
Rev: B
Date: 5/18/2009
Sheet 1 of 2









TEXAS INSTRUMENTS

Drawing Title:
In Circuit Debug Interface (ICDI) Board

Page Title:
JTAG, SWD Mux

Size	Document Number:	Rev
B	0001	B

Date: 4/9/2009 Sheet 2 of 2

A P P E N D I X B

Connection Details

This appendix contains the following sections:

- Component Locations (see page 27)
- Board Dimensions (see page 28)
- Board Connectivity (see page 29)
- References (see page 29)

Component Locations

Figure B-1. EK-LM3S9B92 Evaluation Board Component Locations

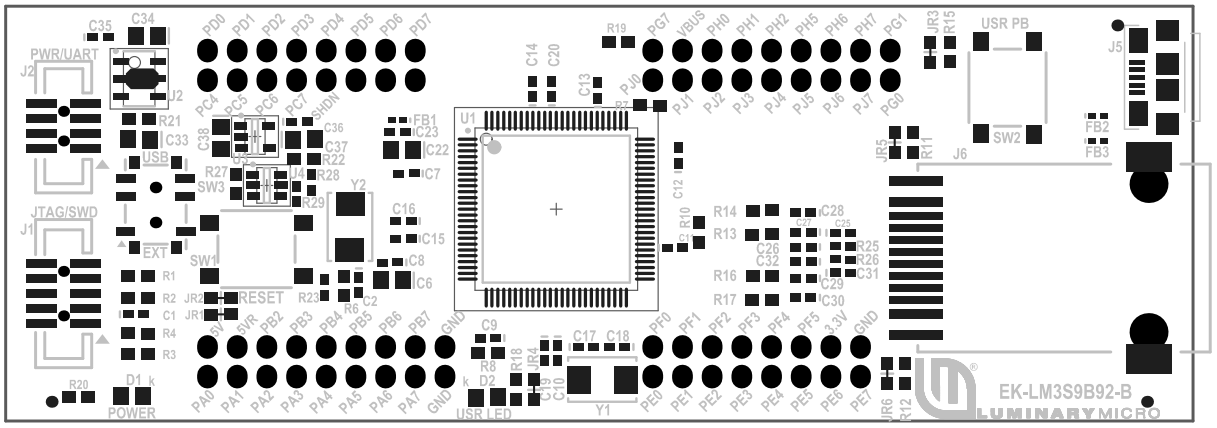
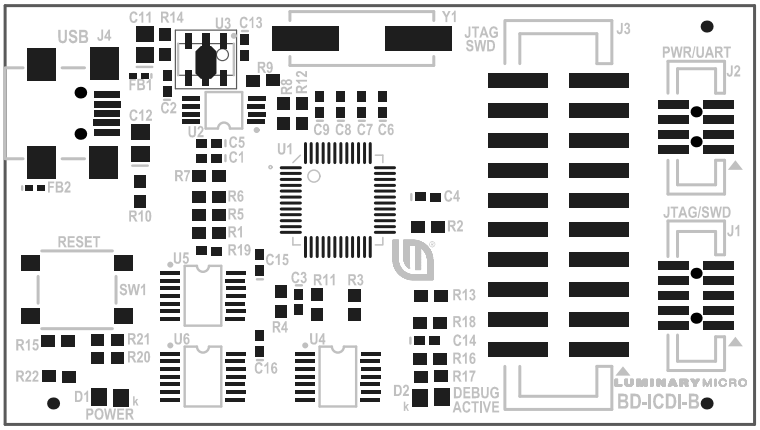


Figure B-2. BD-ICDI Board Component Locations



Board Dimensions

Figure B-3. EK-LM3S9B92 Evaluation Board Dimensions

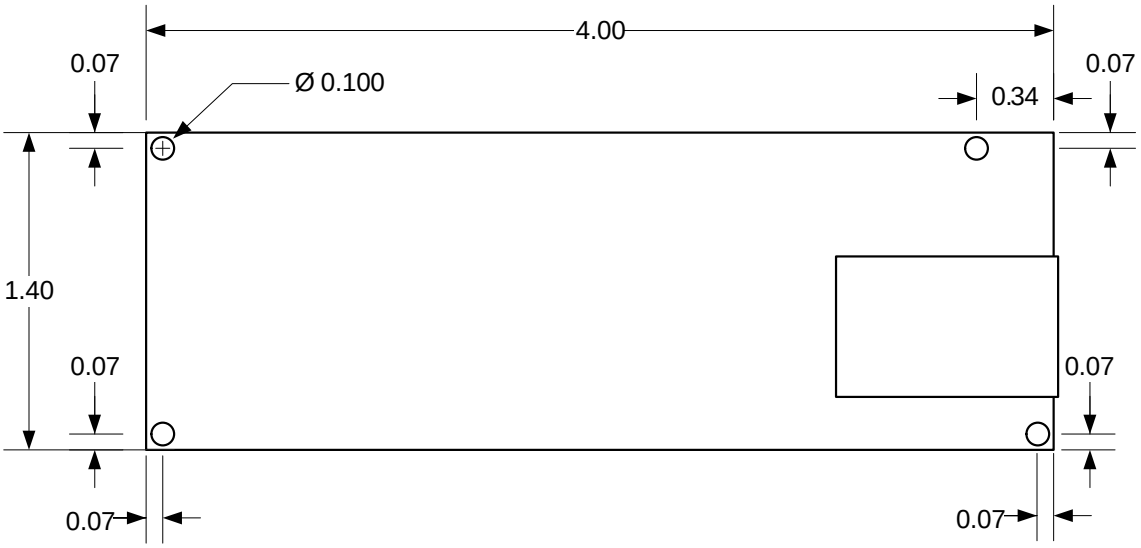
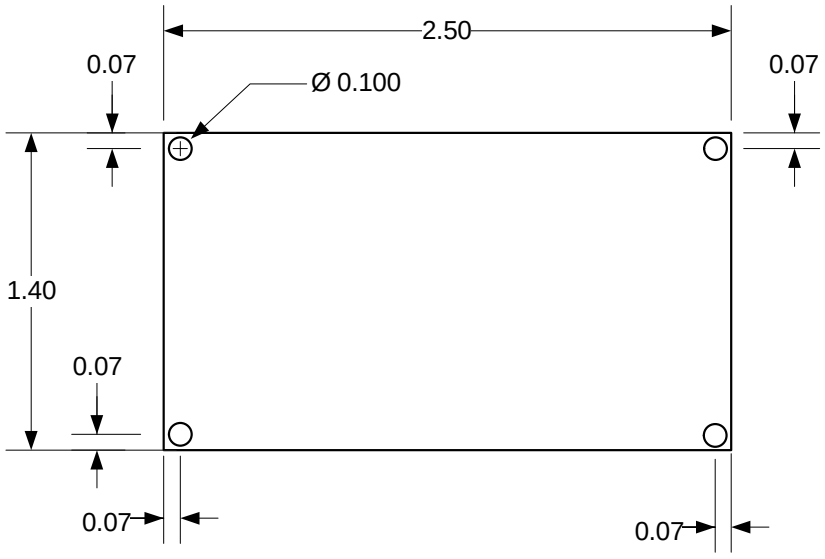
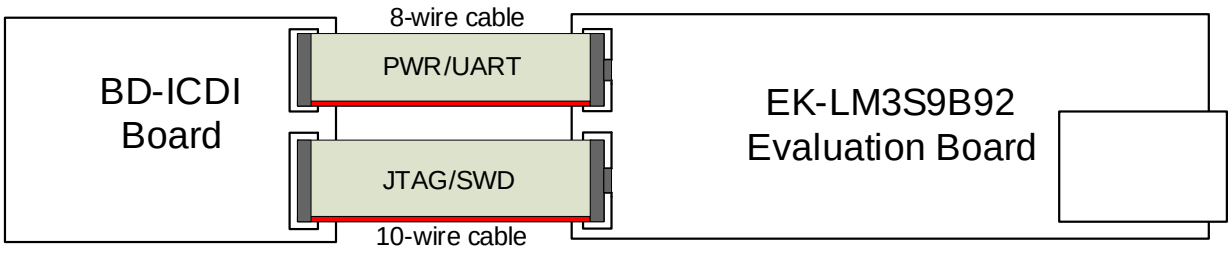


Figure B-4. In-Circuit Debug Interface Board Dimensions



Board Connectivity

Figure B-5. ICDI – EK-LM3S9B92 Board Connectivity



References

In addition to this document, the following references are included on the Stellaris Family Development Kit documentation CD-ROM and are also available for download at www.luminarymicro.com:

- *Stellaris LM3S9B92 Data Sheet*, publication DS-LM3S9B92
- StellarisWare Driver Library
- *StellarisWare Driver Library User's Manual*, publication SW-DRL-UG

Additional references include:

- *FT2232D Dual USB/UART FIFO IC Datasheet*, version 0.91, 2006, Future Technology Devices International Ltd.

APPENDIX C

Microcontroller GPIO Assignments

The following table shows the LM3S9B92 GPIOs used by the EK-LM3S9B92 board. All other GPIOs are available for use and accessible on the test pads.

Table C-1. EK-LM3S9B92 Evaluation Board GPIO Usage

Port	Function	Board Signal	Usage	Description
PA0	U0RX	VCP_RX	UART	Virtual Communications port receive signal from J2 header. To disconnect from header cut JR1 jumper.
PA1	U0TX	VCP_TX		Virtual Communications port transmit signal to J2 header. To disconnect from header cut JR2 jumper.
PB0	USB0ID	USBID	USB	USBID signal from the USB-On-the-Go connector J5.
PB1	USB0VBUS	VBUS		USB VBUS input signal from USB-OTG connector J5 for sensing VBUS levels.
PB4	GPIO	USR_PBn	User	Input from user pushbutton SW2. To disconnect from pushbutton cut JR3 jumper.
PC0	TCK/SWCLK	PC0	JTAG/ SWD	JTAG or SWD clock input
PC1	TMS/SWDIO	PC1		JTAG TMS input or SWD bidirectional signal SWDIO
PC2	TDI	PC2		JTAG TDI signal input.
PC3	TDO/SWO	PC3		JTAG TDO output or SWD trace signal SWO output.
PD0	GPIO	USR_LED	User	Output to user LED D2. To disconnect from LED cut JR4 jumper.
PF2	LED1	ETH_LED1	Ethernet	Output to RJ45 jack J6 yellow LED. To disconnect from LED cut JR5 jumper.
PF3	LED0	ETH_LED0		Output to RJ45 jack J6 green LED. To disconnect from LED cut JR6 jumper.
PH3	USB0EPEN	USBPWR	USB	Output to USB-OTG power switch U3. When set high it enables the USB-OTG power switch to provide USB VBUS power to USB-OTG connector J5. When set low power switch U3 is disabled.
PH4	USB0PFLT	USBPFLT		Overcurrent input status from USB-OTG power switch U3. When high the power switch status is normal. When low an overcurrent condition has been detected by the switch.

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